

TALLAHASSEE AREA MINIMUM TEMPERATURE STUDY

Monthly Report-March 2002

National Weather Service-Tallahassee Department of Meteorology, Florida State University

Introduction

This is the fourth monthly report describing minimum temperatures in the Tallahassee area. It is part of a long term joint research project between the National Weather Service, Tallahassee and the Florida State University Department of Meteorology.

March 2002

The 30 year average March minimum temperature at the Tallahassee Regional Airport is 47.5 degrees. March 2002 was somewhat cooler than normal with an average minimum of 46.3. Twenty observers participated in the study, and their locations are indicated on the attached map (Fig. 1). The observer locations represent a wide spatial distribution across Leon County.

1. TALLAHASSEE AREA MARCH 2002 REVIEW

Table 1 gives daily minimum temperatures as well as means and standard deviations for each location in the network. These data can be used to compare any site with the other nineteen. The coldest readings at the airport occurred on March 1st, March 4th-6th and 22nd-24th. Conversely, March 16th-21st and 25th-26th represented two periods of mild temperatures. These periods demonstrate how changing synoptic scenarios affect the range of minimum temperature. A strong Gulf low and associated warm front on the 1st and 2nd, followed by a quasi-stationary cold front on the 3rd, deluged the area with 8.47 inches of rain at the airport. Wet cold fronts traversed the county on the 12th, 21st, and 26th, and a warm front crossed on the 31st, each depositing between 0.19 and 0.78 inches of rain. In their wake, (except for the warm front), strong high pressure brought in colder air.

As usual with winter cold frontal passages, winds shifted from southeast to northwest, increased and became gusty before noticeably decreasing several days later. For example, northwest winds in the wake of the major cold front averaged 10.5 mph and 11.5 mph respectively, on the 3rd and 4th. Likewise northwest winds averaged 8.9 mph on the 12th in the wake of an early morning cold front, 9.7 mph on the 22nd, 7.3 mph on the 27th and 7.9 mph after an early morning front on the 31st.

Conversely, winds on the mildest nights were from the southeast to southwest, three to five days after the last cold front and/or just ahead of the next one. As the high began to move east and/or south in response to the next approaching front, winds became more easterly then southerly, and local temperatures modified. Winds decreased to 2.2 mph and 2.8 mph on the 5th and 6th, respectively, 3.8 mph on the 14th, 4.0 mph on the 23rd, and 3.4 mph on the 29th.

Therefore, the coldest temperatures occurred several nights after the frontal passages when high pressure sank southward to the local area, and dry north winds subsided to light. Overnight NWS airport observations, on the 4th-7th, and on the 23rd indicated clear skies and unlimited visibilities. This set up ideal conditions for radiational cooling, and temperatures plummeted to their lowest values. Conversely, overnight observations on the mildest nights indicated onshore, relatively moist low-level flow that often generated dense fog with stratus ceilings below 500 feet. Fog was reported at the airport on the 16th-21st, 25th-26th and on the 31st. This significantly limited outgoing radiation, resulting in unseasonably mild predawn lows averaging 60 to 65 degrees.

On the coldest days of the month, the Tallahassee urban heat island showed a range of 15 to 25 degrees. This included 22 and 25 degrees on the 23rd-24th, respectively, 18 degrees on the 1st, and 15 and 17 degrees on the 5th-6th, respectively. This range is significant for a small city like Tallahassee, and it generally increases as winds decrease and radiational cooling increases. During the mildest nights, the ranges were generally 12 degrees or less, and, as expected, smaller than during cold outbreaks. For example, the range was only 8 degrees on the 21st, 9 degrees on the 17th, and 11-13 degrees on the 18th-20th. However, a 16 degree range was noted on the 31st due to a warm front passage that placed the local sites alternately in the cold and warm sectors of the front. This likely accounted for the temperature ranges.

2. MARCH 2002 MINIMUM TEMPERATURE EVALUATION

Figure 2 is a station histogram which shows how each site ranks in comparison to the other nineteen sites during March 2002.

FIGURE 2 HISTOGRAM

Table 2, labeled "Frequency of Extremes" demonstrates another way to view the data. It is more informative than simple raw data or rank histograms, telling how many times (and the percentage of times) that your station ranked as one of the coldest or warmest four sites on a particular day.

a) Coldest and warmest sites

The five coldest sites during March also were the coldest during the previous months. These are (in order) Binkley, Lundy, McCool, Canopy and Oak Ridge. Likewise, four of

the five warmest sites this month were the same as those during the previous months. These include (in order) Brogan, Winsberg, Bellenot, Stuart and Wakulla. Winsberg, a new observer located near downtown, recorded minimums similar to Brogan, the downtown site. This substantiates both the validity of Brogan data and the significant ranges between the downtown area and the more rural suburbs. In fact, all the warmest sites are closest to the downtown area. The monthly consistency in the spatial distribution of cold and warm sites substantiates the data presented.

b)Topography, natural surfaces and soil type

These results continue to show large temperature variations associated with the Tallahassee urban heat island. Not surprisingly, the five coldest sites are located far from downtown in the most rural parts of the county where natural surfaces dominate. Two are in the northwest, two in the south, and one in the southwest quadrants. Topography likely influences the temperature distribution. These coldest sites are all situated west of the Meridian-Monroe roads that divides the county in half with the western half relatively hilly and the eastern half relatively flat. Soil type also may factor into the temperature distribution. North of Tennessee Street, the prevailing soil type is clay, while sand predominates to the south. These deep sands are more effective emitters of radiation which translates to lower nighttime minimums, especially when augmented by the absence of surrounding trees and vegetation. This may contribute to the abundance of cold sites across the southern half of Leon County.

c)Wind speed and direction

The March data continue to validate classical urban heat island studies which indicate that minimum temperatures decrease as you move away from the city center. Perhaps of greater interest is the spatial distribution of cold sites during and after a frontal passage. During a passage and the day after, when northwest and north wind speeds are strongest, locations in the northwest through northeast quadrants, not normally cold spots, rank amongst coldest for that day. These include WCTV, Chiles and Fiorino and are located on the windward side of these slopes. Conversely, the most southern sites, i.e. McCool, are generally not among the coldest. However two days later, when winds typically diminish and radiational cooling dominates, the distribution of coldest sites becomes more evenly distributed (see above). The distribution is no longer based largely on wind speed and direction; but more on the distance from downtown, the amount of natural surface, topography and soil type...all of which will be addressed in detail in future reports and research papers.

d)The Tallahassee Airport (TLH)

During March, the Tallahassee airport was one of the warmest four sites 19 percent of the time, but one of the coldest only 6 percent of the time. Averaging the four month winter season (December-March), it was one of the warmest sites 28 percent and coldest only 4 percent of the time. This substantiates that, contrary to popular belief, the

airport does not represent a cold valley in area temperatures and minimum temperature forecasts for Leon County must address this issue.

Summary

Since this is only the fourth month of Tallahassee minimum temperature data, preliminary assessments may be modified as additional data are collected. Nevertheless, after four months and an entire winter season, the data imply that the Tallahassee urban heat island is more complex, and the minimum temperature ranges are significantly more varied, than previously anticipated. Although temperatures generally decrease with distance from downtown, several factors can alter this circular distribution. In particular, the daily spatial distribution of coldest temperatures appears to be related to synoptic factors, including the effect of frontal and post-frontal weather as well as topography, soil and land use type. Future reports will investigate the reasons for these occurrences in more detail. They also will evaluate winter 2002 data and present a seasonal report.